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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 10/646,709 | 08/25/2003 | Sadayuki Ohnishi | Q76993 | 9821 |
| 23373 | 7590 | 08/09/2005 | EXAMINER | |
| SUGHRUE MION, PLLC 2100 PENNSYLVANIA AVENUE, N.W. SUITE 800 WASHINGTON, DC 20037 | | | CAO, PHAT X | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2814 | |

DATE MAILED: 08/09/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | | |
|------------------------------|------------------------|--|---------------------|--|
| Office Action Summary | Application No. | | Applicant(s) | |
| | 10/646,709 | | OHNISHI, SADAYUKI | |
| | Examiner | | Art Unit | |
| | Phat X. Cao | | 2814 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 May 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 14-24 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☒ Claim(s) 25 and 26 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-7 and 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee (US. 2003/0067077) in view of Lauterbach et al (US. 6,313,517).

Regarding claims 1-3 and 9, Lee (Fig. 1I) discloses a semiconductor device comprising a semiconductor substrate 100 and an interlayer dielectric film formed on the semiconductor substrate, the interlayer dielectric film including a lamination consisting essentially of an adhesive film 118 made of benzocyclobutene polymer (BCB) having benzene ring (aromatic ring) in its molecule and having a specific dielectric constant of about 2.7 (par. [0019]), and a low dielectric constant film 120 constituted essentially by an organic low dielectric constant material having a specific dielectric constant not greater than 4 (pars. [0014] and [0021]). It is noted that the dielectric constant of "about 2.7" allows for the dielectric constant slightly below 2.7. Therefore, Lee does suggest the adhesive film having the dielectric constant as claimed because the claimed dielectric constant of 2.6 and Lee's dielectric constant of slightly below 2.7 are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corporation of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985).

Lee does not disclose that the adhesive film 118 is a silicon-based compound.

However, one skilled in the art would recognize that the adhesive film 118 of Lee would be formed by a silicon-based compound because it is made of a benzocyclobutene unit (BCB) in its molecule, as taught by Lauterbach (column 3, lines 50-67 through column 4, lines 1-16).

Regarding claims 4-7, Lauterbach (column 3, lines 50-66 through column 4, lines 1-16) further teaches that BCB is polymer silicon-based compound containing a silylene unit and formed through polymerization of a monomer containing a divinylsiloxane bisbenzocyclobutene unit. It is noted that the process limitations (formed through polymerization of a monomer containing a divinylsiloxane bisbenzocyclobutene unit, formed through plasma polymerization of the monomer) recited in a "product by process" claim would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claims 10-11, Lee (Fig. 1I) further discloses a metal wiring 116a formed on the semiconductor substrate 100, wherein the adhesive film 118 is formed in contact with the metal wiring 116a and the low dielectric constant film 120 is formed on the adhesive film 118.

3. Claims 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee and Lauterbach et al as applied to claim 10 above, and further in view of Aoki et al (US. 6,787,480).

Neither Lee nor Lauterbach discloses a cap metal formed on the metal wiring

and under the adhesive film.

However, Aoki (Fig. 4c) teaches the forming of a cap metal 24/25 (not labeled, see Fig. 3) on a metal wiring 17 and under a lamination of an adhesive film 7 and an interlayer dielectric 19. Accordingly, it would have been obvious to form the cap metal on the metal wiring 116a and between the metal wiring 116a and the adhesive film 118 of Lee because as taught by Aoki, such cap metal structure would function as a metal diffusion barrier to suppress the increases in interconnection resistance and contact resistance (column 9, lines 64-67 through column 10, lines 1-12).

4. Claims 1-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barth et al (US. 2004,0173908) in view of Lee (US. 2003/0067077).

Regarding claims 1-3 and 9, Barth (Fig. 2) discloses a semiconductor device comprising a semiconductor substrate 110 and an interlayer dielectric film formed on the semiconductor substrate 110, the interlayer dielectric film including a lamination consisting essentially of an adhesive film 118 (par. [0033]) and a low dielectric constant film 119 constituted essentially by an organic low dielectric constant material having a specific dielectric constant not greater than 4 (par. [0031]) and contacting the adhesive film 118.

Barth does not disclose that the adhesive film 118 is a silicon-based compound of BCB having an aromatic ring.

However, Lee (Fig. 1I) teaches an interlayer dielectric film including a lamination consisting essentially of an adhesive film 118 constituted essentially by a silicon-based compound of BCB having a benzene ring (aromatic ring) having a specific dielectric

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constant of about 2.7 (close to 2.6) (par. [0019]) and an organic low dielectric constant film 120 having a specific dielectric constant not greater than 4 (pars. [0014] and [0021]) and contacting the adhesive film 118. Accordingly, it would have been obvious to form the adhesive film 118 of Barth with the material as set forth above because as taught by Lee, such BCB adhesive layer would provide a good adhesion to the metal wiring layer/organic dielectric layer and would prevent a crack issue (par. [0019]).

Regarding claims 4 and 7, the adhesive layer 118 of Lee would contain a silylene unit and would not contain an Si-H bond because it is a polymer of BCB (par. [0019]), which is the same material as BCB as claimed.

Regarding claims 5-6, the process limitations (formed through polymerization of a monomer containing a divinylsiloxane bisbenzocyclobutene unit, formed through plasma polymerization of the monomer) recited in a "product by process" claim would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claims 8, 10 and 12, Barth (Fig. 2) further discloses a metal wiring 115 formed on the semiconductor substrate 110, a metal diffusion barrier 116 of copper alloy is formed on the metal wiring 115, and the adhesive film 118 and the organic low dielectric constant film 119 of MSQ (par. [0031]) are formed in this sequence on the metal diffusion barrier 116.

Regarding claim 11, Lee (Fig. 1I) further teaches that the adhesive film 118 is formed in contact with the metal wiring 116a and the low dielectric constant film 120 is formed on the adhesive film 118.

Allowable Subject Matter

5. Claims 25-26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The prior art of record fails to disclose a second adhesive film arrangement as claimed.

Response to Arguments

6. Applicant argues that Lee discloses the adhesive film having a dielectric constant of about 2.7, but not 2.6 as claimed.

It is noted that the dielectric constant of "about 2.7" allows for the dielectric constant slightly below 2.7. Therefore, Lee does suggest the adhesive film having the dielectric constant as claimed because the claimed dielectric constant of 2.6 and Lee's dielectric constant of slightly below 2.7 are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corporation of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985).

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is 571-272-1703. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PC
August 4, 2005


PHAT X. CAO
PRIMARY EXAMINER